

APPLICATION
FOR
UNITED STATES LETTERS PATENT

TITLE: WHITE GOLD ALLOY

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White Gold Alloy

RELATED APPLICATION

Under 35 USC §119(e)(1), this application claims the benefit of prior U.S. provisional application 60/410,671, filed September 13, 2003, which is hereby incorporated by reference in its entirety.

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TECHNICAL FIELD

This invention relates to gold alloys and more particularly to a range of novel 22-karat white gold alloy formulations.

BACKGROUND

10 White gold formulations possess a bright white platinum color. At a higher karat values, their metallurgical properties may be inferior to more common yellow gold alloys.

White gold was developed as an alternative to platinum when the Russian Revolution disrupted production of that metal during World War I. White golds can be broadly classified into two categories: gold-palladium alloys and gold-nickel alloys.

15 Palladium is added to gold (often with lesser amounts of silver, copper and zinc) to bleach the natural yellow color of pure gold to a gray-white color. A generally accepted rule is that gold alloys containing greater than 15% (w/w) palladium are considered to be "white". 22K (91.67% gold) alloys can contain a maximum of 8.33% palladium, resulting in a 9% palladium formulation that suffers from an undesirable off-yellow color and is much too soft in both the annealed and work hardened states to be fabricated into the most primitive of jewelry products.
20 Less than the maximum percentage of palladium in a 22K white gold formulation balanced with additions of silver, copper and zinc does little to improve the hardness and degrades an already poor color.

In addition to technical issues with relatively high levels of palladium, financial considerations compound the manufacturing problems. In recent years the unit cost of pure
25 palladium has often greatly exceeded that of pure gold. Under these financial circumstances, a 22K (or even lower karat white gold alloys) containing a significant proportion of palladium as a bleaching agent will often exceed the intrinsic value of the same item in pure gold. This

increased in cost over the marked karat quality is without readily apparent benefit and may be unacceptable to jewelry manufacturers and consumers alike.

As with palladium, nickel is added to white gold formulations to bleach the natural yellow color of pure gold. Nickel-bearing white golds are more popular for jewelry fabrication than the palladium containing alloys largely due to their lower cost. Unfortunately, when nickel is used in gold alloys in a sufficient weight percentage to bleach the yellow to the target gray/white color, the undesirable side effects of much greater hardness and a marked reduction in ductility may occur in both the work hardened and fully annealed states. Nickel-bearing white golds of acceptable color are so much harder and brittle as compared to their yellow gold counterparts that many mechanical and hand fabrication techniques cannot be applied to these materials. In general, nickel-bearing white gold alloys suffer from either from poor metallurgical properties or they have reasonable working properties with an off yellow color, or both.

In some cases poor color may be offset by electroplating the finished product. Electroplating finished yellow-tinged “white” gold jewelry with rhodium to whiten the finished jewelry not only increases fabrication and intrinsic metal costs but presents a wide variety of stone setting, sizing, repair, usage and general wear issues. For example, a finger ring that must be increased in size often must be cut then stretched and a gold insert soldered into newly created opening. Rhodium plated jewelry will often blister and crack during cutting, stretching and soldering. Even without cracking and blistering, all or part of the ring must be re-plated after the mechanical sizing operations to standardize the finish.

In summary, white gold jewelry fabricated from either palladium or nickel bearing alloys may suffer from a variety of technical and/or financial problems. Furthermore, as the gold karat quality increases, the weight percentage available for elements to bleach an increasing proportion of yellow gold and for other elemental additives decreases. For example, a 22 karat white gold alloys has only 8.33% of the alloy weight available for (1) bleaching the yellow gold color from 91.67% of the weight to an acceptable gray/white color and (2) developing alloy metallurgical characteristics consistent with standard jewelry manufacturing techniques while maintaining a cost competitive formulation.

SUMMARY

By including zinc, nickel, copper and cobalt in a 22kt gold alloy, it is possible to obtain the desired white gold color in an alloy with satisfactory metallurgical properties and with reasonable raw material costs. In general the resulting alloy has the following composition:

5	gold	90.9 – 93.0%	copper	0.4 – 0.8%
	nickel	6.0 - 7.5%	cobalt	0.02 – 0.50%
	zinc	0.50 – 1.0%		

10 More preferably, these elements are present in the following ranges: Gold \approx 91.67%; Zinc 0.5 to 1.0%; Nickel 6.0 to 7.5%; Copper 0.4 to 0.8 %; Cobalt 0.02 to 0.10%. Typically cobalt is present at least as 0.03% by weight.

The above-described alloy can be produced using a master alloy and mixing the master alloy with gold in approximately a weight ratio that provides 90.9 – 93% gold (nominally 91.67% or 22kt) with the remaining amount being the master alloy. The master alloy
15 composition is (by weight):

nickel 72 –90%;
zinc 4.8 – 18.0% (preferably 6.0 – 12.0%)
copper 4.8- 18.0% (preferably 0.24 – 1.2%); and
cobalt 0.24 to 1.2% (typically cobalt is present at least as 0.4% by weight).

20 The invention also features methods of making jewelry having the above formulation.

The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the invention will be apparent from the description and drawings, and from the claims.

25 DETAILED DESCRIPTION

An example of the new alloys according to my invention has the following composition in weight percent:

	Gold	91.67%
	Zinc	0.66%
30	Nickel	7.00%

Copper 0.60%

Cobalt 0.07%

Total 100.00%

5 Bars, rods and finished jewelry products of the above composition have a pleasing white color similar to platinum jewelry alloys without visible yellow discoloration. Palladium electroplating of the finished pieces generally is not necessary to improve the color.

Bars cast from the above composition roll without cracking or intermediate annealing to 50% of the original thickness. After annealing at about 1425 °F for 15 minutes, the 50% reduced plates can again be reduced 50% in thickness without cracking or other problems.

10 Sheet can be rolled to thicknesses usual to jewelry stamping operations and stamped into two and three-dimensional parts. Such parts can be threaded or formed into springs using fabrication equipment and process common to lower karat yellow and white golds.

Wire made from the same composition can be drawn to diameters typically used for earring posts and chain production without the usual breaking and complicated annealing processes normally required for lower karat white golds.

In order to more easily prepare a uniform 22k white gold composition, a pre-alloy ("master alloy") may be used. An example of the master alloy for the new 22k white gold composition in weight percent is:

Zinc 7.92%

20 Nickel 84.03%

Copper 7.21%

Cobalt 0.84%

Total 100.00%

25 To prepare the new 22k white formulation from the master alloy and fine gold 8.33 weight parts of master alloy would be melted with 91.67 weight parts fine gold.

A number of embodiments of the invention have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention.